A Note on the Studies of Longitudes made by M. Martini, A. Kircher, and J. N. Delisle from the Observations of Travellers to the Far East

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Among the maps deposited by the Bibliothèque de la Marine[1] in 1947 in the Département des Cartes et Plans of the Bibliothèque Nationale, Paris, there is a manuscript map drawn by the prominent astronomer and geographer of the great family of scholars, Joseph Nicolas Delisle (1688-1768). This map (Fig. 1) is catalogued under the classmark, *No 10/2, Collection Delisle.* Its explanatory title gives information of the essential character: *//Observations du Pere Martinius en son Voyage des//Indes, touchant la variation de l'Aiguille, tirées dune Lettre//ecrite de Lisbonne en 1638, au P. Kirker, il ecrivoit cette Lettre de//Lisbonne, parceque les vents contraires l'avoient empeché de passer la//Ligne, et après avoir attendu inutilement le bon vent, près des Isles du Cap//verd, il étoit retourné à Lisbonne par une autre route.//*

The map, neatly drawn in the eighteenth century by the French astronomer-geographer, measures in height 33,5 cm. and in width 20,7 cm. As its descriptive title implies, the geographer made it from the letter of Martinus Martini (1614-1661),[2] sent in 1638 to the great polyhistor Athanasius Kircher (1601-1680).[3]

Martini was seriously interested in geographical studies. His letter, dealing with the method for scientific determination of meridians and latitude, was included in the famous seventeenth-century work on scientific geography by Giovanni Battista Riccioli (1598-1671), *Geographiae et hydrographiae reformatae libri duodecim,*[4] published in Bologna in 1661, and republished in Venice in 1672. Riccioli was recognized as one of the leading scientist-geographers, and much respected by his contemporaries as well as by the distinguished geographers of the eighteenth century.[5]

Martini's observations concerned the variation or declination of the compass needle. He noted his observations starting with his departure from the port of Lisbon. His ship sailed along the African coast to Cape Verde. Because of a storm ("les vents contraires") he returned to Lisbon by another route (see Fig. 1), that in the vicinity of the Azores. After his return to port, he sent his letter to Kircher. Martini finally left for China on March 26, 1640, arriving at Goa on November 6, 1640, and at Macao in 1643. He was in the group of twenty-one companions led by the prominent traveller, Jerome Lobo (1594-1678).[6] From Goa he sent another letter, with new data, to Kircher, dating it November 8, 1640, two days after his arrival.

But Kircher, that genuine polyhistor and curious mathematician, had even earlier than Riccioli gathered the measurements of longitude which were noted by the travelling Jesuits. In his voluminous work, *Magnes sive de arte magnetica opus tripartitum,* published in Rome, 1654, he included much of the information concerning observations and measurements made with the help of the magnetic needle.

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[1] The present paper is written from the material collected during my trip to Europe in 1954, subsidized partly by the American Philosophical Society. For this kind help I am thankful to the Society.

[2] For Martinus Martini, see L. Pfister, *Notices biographiques et bibliographiques sur les Jésuites de l'ancienne mission de Chine, 1552-1773,* 2 vols. (Shanghai, 1932-1934), I, pp. 256-263.

[3] For a short biographical sketch, and especially for bibliographical sources on Athanasius Kircher, see B. Szcześniak, "Athanasius Kircher's *China Illustrata,*" *Osiris,* X (1952), p. 393.

[4] The title-page of the first edition of this great geographical work is as follows: *Geographiae et hydrographiae reformatae libri duodecim quorum argumentum sequens pagina explicabit. Ad illustriss. et excellentiss. D. D. Carolum Emmanuelem a Simiana Marchionem Liburni, etc. Auctore Rev. P. Io. Baptista Ricciolio Ferrarensi Societatis Iesu.* Bononiae, Ex Typographia Haeredis Victorij Benalij. MDCLXI. Superiorum permissu. The letter to A. Kircher from M. Martini on magnetic declination and on the calculation of meridians with its help, dated Goa, 1640, November 8, is in cols. 348a-348b.

[5] Cf. François de Dainville, *La géographie des humanistes* (Paris, 1940), pp. 440-442, quotes the opinion of the great "geographer of the sea," Georges Fournier, who names Riccioli "l'un des plus grands mathématiciens de son temps". Fournier held Riccioli's work in the greatest esteem. Dainville, perhaps, was the first to pay due credit to the forgotten Riccioli.

[6] Cf. L. Pfister, *Notices,* I, p. 256; C. Sommervogel, *Bibliothèque de la Compagnie de Jésus,* 11 vols. and add. (Bruxelles-Paris-Toulouse, 1890-1932), V, cols. 646-651; IV, cols. 1894-1897.

The work of Kircher has a characteristic baroque title-page which we transcribe here in its entirety: *//Athanasii Kircheri//Societatis Iesv//Magnes//sive//de arte magnetica//opvs tripartitum//quo//vniuersa magnetis natura, eiusque in omnibus scientijs & artibus vsus, noua me-//thodo explicatur: ac praeterea e viribus et prodigiosis effectibus magnetica-//rum, aliarumque abditarum naturae motionum in elementis, lapidibus,//plantis, animalibus, elucescentium, multa hucusque incognita//naturae arcana, per physica, medica, chymica, & mathe-//matica omnis generis experimenta recluduntur.//Editio tertia.//Ab ipso authore recognita, emendataque, ac multis nouorum experimentorum//problematis aucta.//* [fleuron-picture] *//Romae MDCLIV. //Sumptibus Blasij Deuersin, & Zanobij Masotti Bibliopolarum.//Typis Vitalis Mascardi. Superiorum permissu, & Priuilegijs.//* This title could be rendered as follows: "Magnes, or a work in three parts on the magnetic art, by Athanasius Kircher of the Society of Jesus: in which the universal nature of the magnet as well as its use in all arts and sciences is explained by a new method: In addition, here are revealed, through all kinds of physical, medical, chemical, and mathematical experiments, many hitherto unknown secrets of nature from the powers and prodigious effects of magnetic as well as other concealed motions of nature in the elements, stones, plants, animals, elucescent things. Third edition. By the author himself revised, emended and augmented with many problems of new experiments. Rome, 1654. Issued at the expense of Blasius Deversin and Zenobius Masotti Publishers. Printed by Vitale Mascardus. With the permission of superiors and with privileges" (Fig. 2).

Kircher believed—and not without good reason—that the travelling missionaries[7] in various parts of the globe were collecting new and reliable measurements based on mathematical calculations and scientific principles. But he, as an Orientalist, was particularly interested in the measurements made in Asia. He searched the correspondence in Roman archives; and, most probably, was responsible for a good part of the work done under his advice. Several of the Jesuit mathematicians were his students in the Collegio Romano.[8]

He expected much information to be found in the Chinese "cosmographical, astronomical and chronographical books". He adds that there was already in the Far East a group of scholars (all Jesuit missionaries) among whom were the following prominent mathematicians who had also collected data of magnetic declination: Didace Pantoja (1571-1618), Wenceslaus Pantaleon Kirwitzer (1586-1626), Joannes Ferrenz (1576-1630). He names Ferrenz the "Plinius Indicus". But they were preceded in this work by Giulio Aleni (1582-1624) who wrote in 1609 from India to the celebrated mathematician Ch. Clavius (1538-1612), informing him about the behaviour of the magnetic needle in various places on the way to India by the Cape of Good Hope.[9] He refers to Vincentius Rodriguez Navarro (1576-1649), "who twenty-eight times went from Portugal to India" collecting determinations of longitude.[10] Then in the letter of Joannes Vreman (1583-1621), dated November 20, 1616, and sent to Rome from Macao, with observations of the magnetic declination, we find determinations of longitude made between the Cape of Good Hope and the Chinese shores of Macao. Finally, says Kircher, in 1638, en route to India, "Martinus Martinius, meus in Mathematicis privatus hic Romae discipulus,"[11] sent many letters[12] to him.

Martini left Lisbon for Goa. The "aequinoctial winds" interrupted his voyage to India and China. Kircher incorporated Martini's measurements, gathered on this tempestuous voyage, into his strange work *Magnes*, together with the longer quotation from the letter.[13] From this letter, as we may see, J. N. Delisle too took the observations and drew the map which is here reproduced for the first time.

For Kircher the treatise *Magnes* became an omnibus of scientific and quasi-scientific information, credulous theories, fantastic diagrams, and even astrological horoscopes. In this collection of naive

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[7] Cf. *Magnes*, p. 315: "Quorum insigni zelo atque ardore non dubio quandoque, et forsan brevi futurum, ut totius Cosmographiae emendationem perfectam, ac tantopere a tota Rep. Lit. nullo non tempore exoptatam, . . ."

[8] A. Kircher in his *China illustrata* (Amsterdam, 1667), ff. 4v.-5r., refers to some of his prominent students who had travelled and laboured in East Asia. See also B. Szcześniak, "Athanasius Kircher's *China illustrata*," *op. cit.*, pp. 393-395.

[9] Cf. A. Kircher, *Magnes*, p. 315.

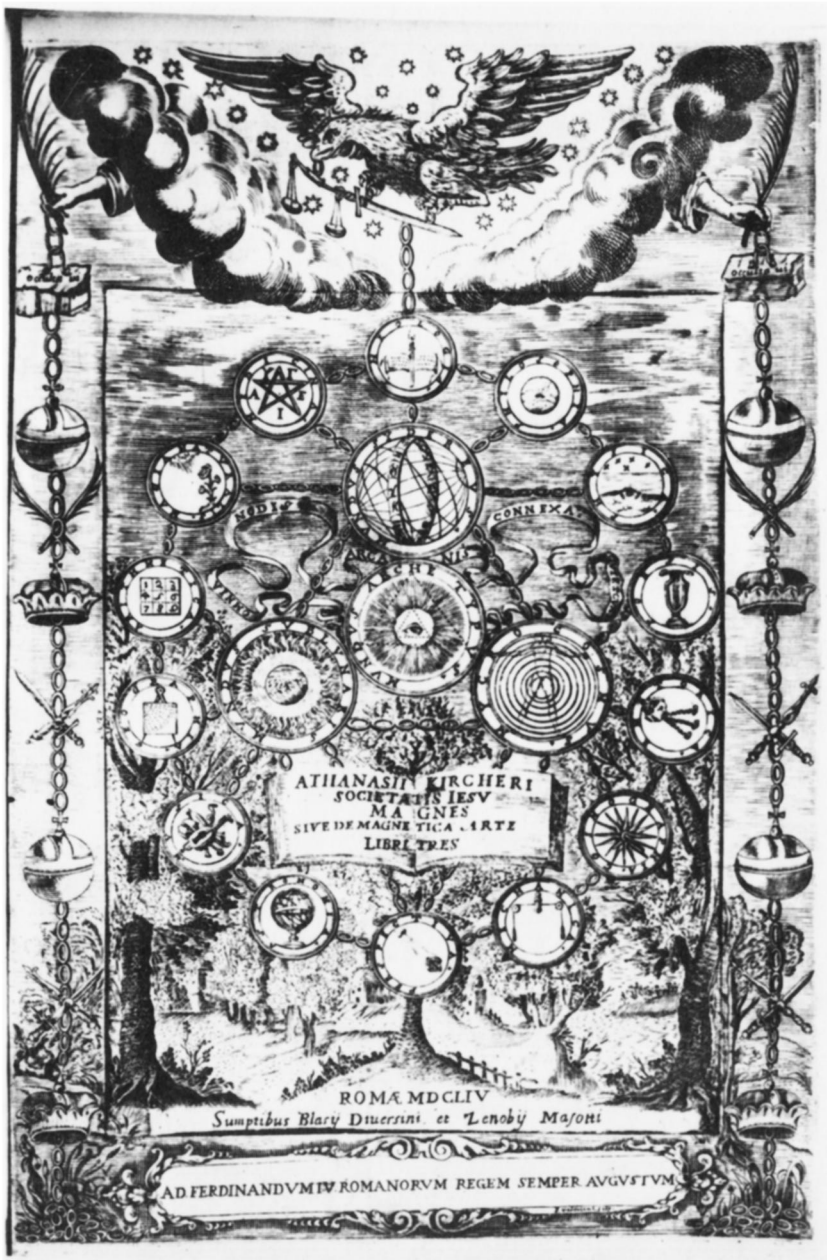
[10] *Ibid.*, p. 315.

[11] *Ibid.*, p. 316.

[12] *Ibid.*, p. 316. The letter is published here for the first time.

[13] *Ibid.*, pp. 316-317.

Fig. 1. MS. MAP BY J. N. DELISLE, SHOWING COMPASS VARIATIONS OBSERVED BY M. MARTINI ON A VOYAGE FROM LISBON, 1638



ATHANASII KIRCHERI
SOCIETATIS IESV.

MAGNES
SIVE
DE ARTE MAGNETICA
OPVS TRIPARTITVM

QVO

Vniuersa Magnetis Natura, eiusque in omnibus Scientijs & Artibus vsus, noua methodo explicatur: ac præterea è viribus & prodigiosis effectibus Magneticarum, aliarumque abditarum Naturæ motionum in Elementis, Lapidibus, Plantis, Animalibus, eluescentium, multa hucusque incognita Naturæ arcana, per Physica, Medica, Chymica, & Mathematica omnis generis Experimenta recluduntur.

EDITIO TERTIA.

Ab ipso Authore recognita, emendataque, ac multis nouorum Experimentorum, & problematis aucta.

ROMÆ MDCLIV.
Sumptibus Blasij Deuersin, & Zanobij Masotti Bibliopolarum.
Typis Vitalis Mascardi. Superiorum permissu, & Priuilegijs.

Fig. 2. Frontispiece and title-page of Athanasius Kircher's "Magnes" (Rome, 1654)

elucubrations we find a chapter on *elixir vitae* (pp. 555-556), on sirens living in the Oriental seas (pp. 531-532), on the 'magnes' of lovers whose bodies are inclined to stick to each other because of the 'magnes' of love (pp. 605-608), on the 'magnes' of *facinus* (pp. 608-611), and on many other facts and fancies which the polyhistor laboriously collected.

There is, however, some valuable material, especially that portion treating of the many measurements and data relating to the unsolved problem of longitude and its determination, under the title "Geographia magnetica".[14] No wonder that this valuable chapter (pp. 292-350) attracted Delisle, who could still in the beginning of the eighteenth century use the material for his restoration of a true geographical and scientific estimate of the measurement of the globe.[15]

For a modern geographer the attached measurements are particularly eloquent, especially when compared with the knowledge of to-day:

	G.	M.
In Portu Ulyssiponensi magnes declinat usque ad Maderam	7	39
Apud Maderam paulatim decrescens usque ad Occidentalem Insulae partem, ubi variat	5	49
In altitudine 28. grad. 25 min.	6	3
Ad Meridionalem partem Palmae 20. Leucis	7	20
Et hoc modo usque ad Caput Viride per totum iter		
Ad Occidentem Capitis Viridis 40. Leucis	7	30
In Guinea sub 7. grad, latitud	8	0
220. Leucis ad Occidentem Capitis sub altitudine 18. grad.	5	0
Fugitur vero acus in eadem prope altitudine 340. Leucis a Capite Veridi	0	0
A gradu 15. altitud. usque ad 18. fixa est acus, sc. remota 150. leucis, et magis longe ab Insulis Capitis Viridis	0	0
A 28. usque ad 30. gr. altit. declinat acus ad Occidentalem plagam Insulae Florum, quae una ex Ferceris est, ab ea versus Occidentem distantem 40. Leucas[16]	1	12

According to Kircher—and he knew the movements of his confrères from Rome—measurements and observations pertaining to the latitude were gathered in India about that time by two Jesuits: Chrysostomus Gallo (fl. ca. 1630) and Christophorus Borri (1583-1632). At the same time (ca. 1630) two other missionaries returned to Rome from the Philippines: Diego de Bobadilla (1590-1648) and Simeon Cotta (fl. ca. 1630),[17] who had in the Southern Ocean, "vulgo del Zur", observed the declination of the needle, which "in certain places increases declination continuously to a points of the seas".

But there is another letter of Martinus Martini—perhaps more interesting to the historians of geography—inserted by Kircher in the *Magnes*.[18] It discusses the declination of 'magnes' in various longitudes and the method of determining longitude with the help of the magnetic needle. This is dated November 8, 1640, at Goa. Some measurements, from the Cape of St. Augustine to the Port of Goa, are attached to it—fifteen in all. The letter concludes with a remark that he "observed many places in the relation to the South Pole; the spots on the sun, the spots on the Milky Way, one in the Altar and another in the feet of the

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[14] *Ibid.*, pp. 292-350.

[15] Delisle apparently gave considerable credit to Kircher's collected measurements. He used his observations made in the Mediterranean Sea; cf. *Magnes*, pp. 317-318. In the Département de Géographie of the Bibliothèque Nationale we may see a manuscript map of the Mediterranean by the prominent geographer, catalogued under the press mark: Pl. 1. D^{m}. 0. N 10^{8}. The same Kircherian measurements were discussed by G. B. Riccioli in his *Geographia reformata*, p. 378: Longitudinem Calpis, vulgo Gibraltar in Hispania Reformata obtinuimus grad. 15.51 ab insula Palma, contra quam, vel paululo orientalior est Septa, vulgo Ceuta, ubi alias erat Abila, longitudinem habens gr. 15.55. Tingis autem, vulgo Tanger occidentalior est Abila, seu Septa. 30′ . . . .

[16] Cf. A. Kircher, *Magnes*, p. 317, conclusion of the observations of distances between the Island of Flores and the mainland of Portugal and the behaviour of the magnetic needle in these regions: Hac Insula Flores ex parte Meridiei habet etiam parvam Insulam magnitudine unius Leucae, ut nobis Nauclerus dixit, atque 60. Leucis ab hac Insula versus Occidentem fixam esse acum Magneticam, adeo ut 60. Leucis ab Insula de Flores magnes declinet 0.0. at 80. Leucis a terra Lusitaniae in altitudine 30.½ declinat 7. grad. 10 min. ad ortum. Atque haec pauca R. V. transmitto, quia sunt certiora circa distantias a terra: alias declinationes non addo sequenti anno ex India R. V. favente Deo plurima alia transmissurus."

[17] I have not found any data relating to Simeon Cotta. There was a little-known Jesuit missionary in India and Moluccas, Ferdinandus Cotta, a Portuguese, born 1603, who was admitted to the Society in India in 1625. Cf. *Archivum Historicum Societatis Iesu*, I (1933), p. 251.

[18] Cf. *Magnes*, pp. 348-350. This is entitled by A. Kircher, "Litterae P. Martini Societatis Iesu, datae Goa Anno 1640. 8. Novemb. ad Authorem, in quibus plures observationes Magneticae, aliaque scitu digna adnotantur."

Centaur; the dusk of the evenings of these regions; but"—he ends— "we shall speak of these things with all others in the proper place".[19]

Undoubtedly M. Martini deserved some recognition in the field of geography. But the Jesuit writers exaggerated his merits.[20] There was no particular greatness in him. His name is remembered by the *Novus atlas Sinensis* (Amsterdam, 1655), in respect of the compilation and publication of the material, which was collected by several missionaries residing in China, among them the great geographer and sinologist Michael Boym (1612-1659), a celebrated Polish Jesuit.[21] Martini's measurements and observations were of special value even in the eighteenth century, one hundred years after the memorable voyage to the Far East, and to China in particular.

The search for the exact determination of longitude constitutes an epic story. Louis XIV's wise minister, Jean Baptist Colbert, invited the foremost scientists of Europe to investigate it. The Académie Royale became a centre for international scholars, and two of them, Christian Huygens (1629-1695), a Dutchman, and Giovanni Domenico Cassini (1625-1712), an Italian, arrived in 1673 at a correct method[22] of measuring the longitude of various places of the earth. Before them, the Jesuits, persisting in their effort, had computed the meridians. Martini[23] used the same means and applied the same method, in my opinion, as that followed later by the English scholar, Edmund Halley, in his search for the determination of meridians.

The manuscript map of the part of the African coast, drawn by J. N. Delisle, has a documentary interest for the historian of cartography. It is primarily a result of the search for the establishment of longitude by use of the magnetic needle. Martinus wrote[24] from Goa (on November 8, 1640) to Kircher, his former teacher in the Collegio Romano:

"The determination of longitude by a magnetic needle is no longer impossible for me, indeed, at least theoretically I consider the methods to have been altogether established. In practice, however, I have been impeded, for lack of time, but in my mind I see it thus:

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[19] *Ibid.*, p. 350.

[20] Cf. Henri Bernard, "Les étapes de la cartographie scientifique pour la Chine et les pays voisins depuis le XVI[e] jusqu'à la fin du XVIII[e] siècle," *Monumenta Serica*, I (1935-1936), pp. 418, *et seq.*

[21] For Boym's sinological contributions, see B. Szcześniak, "The Writings of Michael Boym," *Monumenta Serica*, XIV (1949-1955), pp. 481-538. For the description and evaluation of Boym's atlas of China, see *idem*, "The Atlas and Geographic Description of China: A Manuscript of Michael Boym (1612-1659)," *Journal of the American Oriental Society*, 73 (1953), pp. 65-77.

[22] For the account of the efforts and methods applied in the search for longitude, see L. A. Brown, *The Story of Maps* (Boston, 1949), pp. 208-240; also François de Dainville, *La géographie des humanistes*, pp. 445-454, *et al.*

[23] In my opinion the great Edmund Halley (1656-1742), whom English historians exalt to the heavens, followed Martini's example of measurement of magnetic variations. He made his famous voyage in 1699 and 1700. As a result he published a chart "Shewing the Variations of the Compass in the Western and Southern Oceans as Observed in ye Year 1700 by his Ma[ties] Command by Edm. Halley." See "Dr. Halley's First Voyage: A Journal of a Voyage Made for Discovery of the Rule of the Variation of the Compas . . . 1699 and 1700," in the *Philosophical Transactions of the Royal Society*, 1714, Nos. 148, 195, 341. There is also a work on the theory of the variation of the magnetical compass, *Philosophical Transactions of the Royal Society of London*, 1683, p. 624, *et seq.*

[24] Following is an excerpt from Martini's Latin letter explaining his method of determining the latitude: "Inventio longitudinis per Magnetem apud me non amplius est impossibilis, immo inventum omnino existimo saltem speculative; practice autem pro temporis brevitatem sum hactenus expertus, sed res in mente ita se habet. In Mappa Hydrographica communi modo Nauclerorum facta, per duo loca, quam proxima duobus Meridianis Fixe Acus, verbi gratia per Caput das Agulhas, et per Hierosolymam, ubi magnes figit, ducatur recta linea per totam cartae latitudinem extenta. Huic recta linea ducantur parallelae, per omnia loca in quibus figit Magnes, verbi gratia per Insulam Corvi, per Petram Blancam, Per Cantonis ostium; et praeterea per loca ubi maxima est deviatio Magnetis. Hae lineae licet in Polos non concurrant, repraesentant tamen Magneticum Meridianum. Has lineas, divido in gradus non Aequinoctiales, sed Magneticos, proportione, de qua mox. Sed ante divisionem adverto: lineam quandam debere graduari ea ratione, ut eius gradus solum sint pertinentes ad maximam usque declinationem, quam habet Magnes, tum ad Ortum, tum ad Occasum eiusdem lineae, non autem valeant usque ad aliam lineam. Sed tunc altera linea separato huic spatio inserviet. Verbi gratia linea, quam duxi per insulam Corvi, serviet ex parte Orientis, usque ad Insulas Tristani de Cunha; deinde usque ad Caput de las Agulhas serviet linea per illud ducta, servietque usque ad Insulam S. Laurentii, ubi est maxima deviatio: post hanc serviet, quae dicitur Petram Blancam: sapienti pauca.

Iam ad divisionem graduum Magneticorum veniamus, et uno meridiano magnetico diviso, eadem regula alios dividemus, variata tantem proportione, sicut in diversis orbis quadrantibus Magnes improportionaliter variat . . ." Cf. A. Kircher, *Magnes*, p. 317.

In the hydrographic map made in the common fashion of navigators a straight line is drawn over the whole width of the map through two places as close as possible to two meridians of the Stationary Needle—for example through the Cape of Agulhas and through Jerusalem, where the magnetic needle halts. To this straight line are drawn parallels through all the places at which the needle stops: for example, through the Island of Corfu, through the White Rock [Pedra Branca], through the port of Canton; and also through the places where the magnetic deviation is greatest. Although these lines do not meet at the Poles, still they represent the magnetic meridian. These lines are divided proportionally into degrees, not equinoctial but magnetic. About this proportion I shall speak later.

But before the division I note that any one line must be so graduated that its degrees pertain solely to the greatest declination which the magnet has, both to the East and West of that same line, but would not reach the other line. But then another line would occupy this separate space. For example, the line which I drew through the Island of Corfu will serve for the East as far as the Island of Tristan de Cunha; then as far as the Cape of Agulhas the line drawn through it will serve, and it will serve as far as the Island of St. Lawrence, where is the greatest deviation. After this the line will serve, which is called White Rock (Pedra Branca). Few words suffice for an intelligent man.

Now let us approach the division of magnetic degrees and after one magnetic meridian has been divided, we divide the others by the same rule, varying only the proportion as the magnetic needle varies in different proportions in other quarters of the globe. . ."

The map of Delisle was a result of his scepticism and lack of belief in the old geography. He knew that the graphic image of the world must be revised, as it was based on observations collected by unscientific methods. He started to check data for a new cartography, based on methodical research and on astronomical and geodetic measurements. His enormous collection of notes and maps was acquired by Louis XV and deposited in the Dépôt de la Marine, Paris.[25] The map of the African coast, which we publish (Fig. 1) with the present article, is from this material now in the Département des Cartes et Plans, in the Bibliothèque Nationale.

[25] Cf. Albert Isnard, "Joseph-Nicolas Delisle, sa biographie et sa collection de cartes géographiques à la Bibliothèque Nationale," *Bulletin de la Section de géographie*, XXX (Paris, 1915), pp. 34-168. L. Breitfuss, "Early Maps of North-Asia and the Lands around North Pacific: Controversy between G. F. Müller and N. Delisle," *Imago Mundi*, III (1939), pp. 87-99.